HOVERFLIES (DIP.: SYRPHIDAE) WITH A DRINKING HABIT

MARTIN C. D. SPEIGHT

Research Branch, National Parks & Wildlife, 7 Ely Place, Dublin 2, Ireland.
E-mail: speightm@indigo.ie

Introduction

HAVING REPEATEDLY observed hoverflies drinking, I have attempted to put these observations together in this note, in the hope it may stimulate interest in this apparently neglected topic. Citation of individual observations has largely been avoided. Instead, an overview is provided of the circumstances in which drinking has been observed, with discussion of their potential implications. The note ends with a summary list of the 87 European species I have observed drinking.

Circumstances under which drinking occurs

Most of my observations have been made in forest habitats in southern Europe and should be considered in that context. It is a moot point whether they would relate equally to other habitat conditions or parts of the world.

Three factors may be identified which have a strong influence upon whether or no syrphids may be found drinking: weather conditions, type of location and time of day.

Weather conditions

In general, drinking by syrphids becomes noticeable when shade temperatures exceed 25°C, humidity is relatively low (I am not able to provide precise values), available sources of water are few and it is sunny. As the temperature mounts above 25°C drinking visits become progressively more frequent until temperatures exceed 32°C-33°C, when visits again diminish in frequency. The increase in drinking activity with temperature is due to both increase in numbers of individuals and increase in the number of species arriving to drink. Similarly, the decrease in drinking activity above 33°C involves diminution in both numbers of individuals and number of species.

Type of location

Use made of water sources varies according to whether they are running or standing water, easy of access by flight, in the sun and have an appropriate marginal zone. Edges of streams or rivers may be used, as may be the edges of pools or temporary puddles, patches of damp mud or sand, active sap runs or the wet surfaces of fresh cow dung.

In many instances it is difficult to observe drinking along the margins of streams or rivers, because the multiplicity of potentially appropriate drinking sites reduces the frequency with which any one site will be visited. However, experience, under conditions where appropriate drinking sites along streams are few and far between, suggests stream edges are perhaps the most favoured type of location (Table 1, st).

To generalise, stretches of stream that are for 2-3 metres in direct sunlight and have a mud, sand or gravel strip along the margin, receive maximal use. Characteristically, such stretches of water are only in the sun for limited periods of the day in forested conditions, going in and out of shadow as the angle of the sun's rays changes. When such a stretch of water passes into shadow its margin is hardly visited by drinking syrphids, even in periods when drinking activity might be expected to be maximal e.g. at mid-day. In instances where the water is in the sun but the margin is shaded, visits continue undiminished. I would postulate that the attraction of running water in the sun is due to the multiple reflections given off by its rippled surface, visible to syrphids which happen to fly above it. I did once attempt a rather primitive experiment to test this, using two trays containing water, one of them white and the other lined by crinkled, metallic cooking foil, laid on the ground, in the sun, on a track in alluvial softwood forest. The latter tray attracted *Ferdinandea cuprea* and *Helophilus pendulus,* while in the same time period the former attracted nothing (users of "water traps", please note!). I followed this up at a different location (in *Fagus/Abies* forest) by simply waiting beside a large (1.5 x 0.5m), crinkled piece of the same foil laid upon the ground, in the sun, to one side of a forest track. This piece of foil attracted *Eristalis similis*, *Meligramma cingulata* (Egg.), *Myathropa florea*, *Syrphus ribesii* and the stratiomyiid *Chloromyia speciosa* (Macquart.). The attractiveness of the roofs of parked cars to both syrphids and water beetles (!) on hot days is an analogous phenomenon with presumably a similar explanation.

The use made of any water source seems to be much influenced by whether or no it is in the sun, being visited for drinking purposes while the sunlight falls upon it, but not otherwise. This effect is particularly dramatic in the case of sap runs (Table 1, sa), which are often in the sun only briefly when the sun is at its zenith. During the course of 30 minutes to one hour, while a sap run is in the sun, it may be visited by a large number of individuals of a range of species, arriving in rapid succession – species rarely seen otherwise and not found drinking along stream margins. Some of the sap-run visitors seem to visit stream margins only under particular circumstances. *Sphegina* species provide an interesting example. I have not found this genus drinking along stream margins except where the water flows over a near-vertical surface, like a small waterfall. There, *Sphegina* may be found drinking at the edge of the water film, either on the wet rock surface or among wet moss.

The edges of pools or puddles seem to be visited by a narrower range of species than stream margins, and by the same species that visit patches of wet mud or sand (Table 1, d). However, under exceptional circumstances even patches of wet mud can prove highly attractive. The most extreme instance of this phenomenon I have experienced was on a hot day at c1400 metres, in forests in a part of the Swiss Jura which is entirely devoid of surface water except at the lowest altitudes (c700 metres). Two days after rain, one solitary section of a partially shaded track edge was still showing a feeble seepage of water, in the form of damp mud, for a distance of some 20 metres. Enormous numbers of syrphids accumulated along this stretch of track in the late afternoon and evening, attempting to drink. Visits continued until the last vestiges of sunlight had passed from the track surface. Among the species which arrived were a number I have never seen coming to drink elsewhere.

Even small and extremely transitory patches of wet ground can prove attractive to syrphids. A bottle of mineral water, inadvertently spilt on leaf litter in an arid *Fagus* forest, very quickly attracted both *Heringia (Neocnemodon) latitarsis* and *Merodon avidus* on one occasion. This wet patch virtually disappeared within half an hour. *Heringia* species, in particular, seem adept at locating and using small patches of wet mud for drinking purposes. Wet cow dung (Table 1, c), another temporary source of moisture, which may be deposited far from stream margins or other water sources, would seem to have a small but rather particular fauna of syrphid visitors (excluding species which may arrive to oviposit), including *Ferdinandea aurea*.

The use made of all these sources of moisture is subject to accessibility. Without clear line of flight down to and away from a potential drinking site it is little used. Larger species, like those of *Milesia*, *Spilomyia* or *Volucella*, seem to require a sizeable atrium under the canopy, above drinking sites they frequent. This is also so for *Callicera* species, which seem to prefer an almost cathedralesque space above their drinking stations.

Time of day

Within the general framework provided by the times at which a site is in the sun and temperatures are appropriate, at a given season and place syrphids come to drink at times seemingly characteristic for the species involved. To give contrasting examples, although during July *Milesia semiluctifera* and *Spilomyia saltuum* may be found feeding together on the same flowers and drinking at the same streams in evergreen oak (*Quercus ilex*/*Q. suber*) forest in southern France, they do not drink at the same times. Both species feed at flowers in the morning, appearing at about 09.00 hours and disappearing by 11.00 hours. *S. saltuum* may from then on be found drinking at stream margins until the early afternoon, after which it again disappears. On the same day, *M.semiluctifera* does not arrive to drink until the early afternoon, whereafter it continues to visit stream margins until sunlight leaves them for good in the evening (here about 18.00 hours). Such "drinking hours" can clearly vary with season. Thus *Callicera* species appear to drink at stream margins at mid-day in July, but appear at both mid-day and early evening in September. Then there are those species which may be present in the vicinity of drinking stations but do not seem to visit them. In my experience, most *Eumerus* species fall into this category. One obvious example is *Eumerus flavitarsis*, the adults of which are characteristically found along stream margins. I have never seen this species engage in drinking behaviour.

Behaviour of the drinking fly

In a typical occurrence of drinking by a syrphid, as recognised in this article, the insect settles on a moist substrate onto/into which it extends its mouthparts, thereafter remaining motionless for a time interval of 30 seconds to five minutes. Following this it flies away from the drinking site entirely, without engaging in any other activity there. Most syrphids flying down to drink do so without any apparent hesitation, or prolonged process of selecting a place to settle, and once settled they do remain almost entirely motionless. Essentially, they have to be observed as they arrive, because once in place drinking they are almost impossible to see – even the larger and more highly-coloured species. Exceptions to this typical drinking behaviour occur in genera like *Eupeodes, Platycheirus* and *Syrphus*, which tend to hover some centimetres above the surface for some seconds, before they settle. *Heringia* spends some seconds zig-zagging from side to side, very rapidly, just above the surface, before settling. The *Eumerus* species which do visit water sources tend to remain motionless for only a few seconds once settled, after which they move perhaps a metre before re-settling, a process repeated a number of times during one visit. And *Spilomyia* does not remain entirely motionless once settled, but instead often vibrates its wings, or waves them about slightly, in a fashion somewhat reminiscent of tephritids.

Syrphids do not occur by themselves at drinking stations, but are usually accompanied by other insects which have also arrived to drink and by representatives of the indigenous water edge fauna. A noticeable feature of the drinking assemblage is that syrphid mimics of aculeate Hymenoptera are frequently found drinking in the company of their putative models. Intriguingly, although model and mimic frequently drink within a metre of each other, they rarely actually drink together, seemingly having small, but distinct, differences in the preferred characteristics of the sites at which they settle. The various social wasps and the honey bee (*Apis*), in particular, arrive repeatedly on the same few square centimetres of surface used previously by their own species. *Apis*, *Vespa crabro, Vespula* species and *Pollistes* species are all frequent visitors to stream margins to drink. *V. crabro* is so similar to *Milesia crabroniformis* (in both appearance and sound) that where they both arrive to drink distinguishing them can be difficult, though the wasp carries its wings folded over its abdomen once settled, which is not so in *Milesia*. Even more difficult is detecting *Spilomyia* among a mixed bunch of *Pollistes* species. But *Pollistes* usually take a considerable time in selecting places to settle, swinging from side to side above the generally-preferred spot, and once settled they tend to pulse the abdomen and hold their wings steady, unlike *Spilomyia*.

Given that some of the insects found drinking can be predators of others accompanying them, it is perhaps surprising that there is an almost total lack of predatory behaviour among the drinkers. It would appear that aculeates which arrive to drink are there for that sole purpose. Indeed, syrphids which arrive to drink do so largely undisturbed. At stream edges there are occasional perturbations caused by patrolling dragonflies, notably *Calopteryx, Cordulegaster* or *Gomphus* species, but the only resident predators which seem to lie in wait for the unwary drinker are small lizards. A more bizarre interference originates with the conopids which characteristically station themselves along stream margins, awaiting the arrival of appropriate aculeate hosts to drink. These conopids (*Leopoldius* and small *Conops* species) may be numerous and not infrequently "attack" drinking syrphids, causing them to fly off.

Where standing or slowly-moving water is present, at least one further drinking technique may be observed among insect visitors. *Pollistes* wasps, especially, may alight directly onto the water surface, with all legs widely spread, so that they may drink while floating on the surface film. They then take flight directly from this floating position. This technique is not much used by syrphids in general, but may be employed at least by *Eupeodes corollae*, when visiting small bodies of still water, like garden ponds. A third technique, which may, however, not involve drinking at all, is very similar to the "dapping" activity of mayflies and tabanids. Dapping tabanids swoop down to the water surface of small streams, to briefly insert the tip of the abdomen into the water, for purposes of oviposition. This event is conducted very rapidly, and the insect flies up from the surface immediately afterwards. An egg-laying tabanid may touch the water surface in this way two or three times in quick succession, while flying over a stretch of stream surface, after which it zooms away from the stream. In some instances, it looks as though the fly inserts not the tip of the abdomen, but the mouthparts, into the water. But it would take high-speed photography to really establish what is taking place. On occasion, I have seen *Callicera* performing this same action over streams, but am unable to state whether oviposition or drinking was involved - I cannot even be sure whether the insects concerned were male or female because it was virtually impossible to capture them.

Discussion

That under certain circumstances adult syrphids visit sources of water in order to drink is indisputable. The extent to which access to water for drinking is a requirement for syrphids is less clear.

When conditions have been optimal for observing drinking by syrphids I have only exceptionally gained the impression that the entire local population of some species might be coming to drink. Without experimentation, discussion of this point must remain largely conjectural. However, my general assessment of the situation would be that only a subset of the individuals comprising the local population of a species visits drinking stations on any one day. An associated conclusion is that only individuals from habitats within c100 metres of a drinking station will visit it. If these deductions are correct, they might be taken to imply that access to water is not critical for adult syrphids. However, they might equally be used to argue that, in hotter, drier parts of southern Europe, at least, accessibility of water may well dictate the distribution of some forest species, restricting them to the vicinity of water sources which remain available during the largely arid months, even if appropriate larval habitat occurs throughout the surrounding forests. Certainly, the consistent and persistent use made of forest stream margins, for drinking purposes, would argue that access to such a source of water must confer some advantage on the local syrphid populations, at the very least.

The increased frequency of drinking activity under hot conditions might lead one to believe that the flies are drinking primarily to replace lost water and avoid desiccation. But other insects are known to drink not only to obtain water but also to obtain necessary minerals. So far as I am aware, there has been no investigation of this aspect of drinking activity for European syrphids. Drinking from moist cow-dung or from sap runs, in particular, would undoubtedly lead to ingestion of a range of potential nutrients, either in solution or suspension, and it may be entirely inappropriate to view these activities as manifesting primarily a need for water.

Finally, there is the intriguing question of the potential role of mimicry in the drinking procedure. The theoretical advantages of mimicry are easy to understand, but specific circumstances in which mimicry may confer real advantage are less easy to identify. Motionless while drinking at a stream margin, large syrphids like *Milesia crabroniformis* and *Spilomyia* species are arguably at their most vulnerable. If the mimicry by these syrphids of *Vespa crabro* and *Pollistes* species, respectively, ever has any real significance, it must surely be an active force when they are drinking in the company of their models.

This short account is generously sprinkled with supposition and interpretation not backed by rigorous experimentation. For this I make no apology. As I see it, there is a need to show that syrphid drinking behaviour requires more rigorous investigation – the extent to which the adult fly's requirement for accessible water sources dictates either distribution or behaviour of a species is at the moment impossible to gauge. If this short essay precipitates some research on the topic it will have served its purpose. A second objective would be met if more of those interested in syrphids set out to observe syrphid drinking behaviour for themselves – they may well find that, on a hot afternoon, a rest beside a patch of sun reaching down to an otherwise shady forest stream can be transformed into a most productive experience!

Table 1: **syrphids observed drinking**. The species are listed in the left-hand column, the substrate(s) on which they have been observed drinking in the right-hand column.

c = cow-dung; d = damp mud/sand; sa = sap-run; st = stream edge

SPECIES	substrate
Anasimyia contracta Claussen & Torp, 1980	d
Baccha elongata (Fabricius), 1775	st
Brachyopa dorsata Zetterstedt, 1837	d
Brachyopa insensilis Collin, 1939	sa
Brachyopa panzeri Goffe, 1945	sa
Brachyopa pilosa Collin, 1939	sa
Brachyopa scutellaris Robineau-Desvoidy, 1843	sa, st
Brachyopa vittata Zetterstedt, 1843	d
Brachypalpus chrysites Egger, 1859	d
Callicera aurata (Rossi), 1790	st
Callicera fagesii Guerin-Meneville, 1844	st
Callicera macquarti Rondani, 1844	st
Callicera spinolae Rondani, 1844	st
Ceriana vespiformis (Latreille), 1804	st
Chalcosyrphus nemorum (Fabricius), 1805	st
Cheilosia aerea Dufour, 1848	st
Cheilosia albipila Meigen, 1838	d
Cheilosia chrysocoma (Meigen), 1822	d
Cheilosia faucis Becker, 1894	d
Cheilosia frontalis Loew, 1857	d
Cheilosia lasiopa Kowarz, 1885	d
Cheilosia mutabilis (Fallen), 1817	st
Cheilosia pubera (Zetterstedt), 1838	d
Cheilosia rhynchops Egger, 1860	d
Cheilosia scutellata (Fallen), 1817	d, st

SPECIES	substrate
Cheilosia soror (Zetterstedt), 1843	st
Cheilosia urbana (Meigen), 1822	d
Chrysogaster solstitialis (Fallen), 1817	st
Chrysogaster virescens Loew, 1854	st
Chrysotoxum octomaculatum Curtis, 1837	st
Criorhina berberina (Fabricius), 1805	st
Criorhina floccosa (Meigen), 1822	sa
Didea fasciata Macquart, 1834	st
Doros destillatorius Mik, 1885	st
Episyrphus balteatus (DeGeer), 1776	d, st
Eristalinus taeniops (Wiedemann), 1818	st
Eristalis arbustorum (L.), 1758	st
Eristalis interrupta (Poda), 1761	d
Eristalis pertinax (Scopoli), 1763	d, st
Eristalis similis (Fallen), 1817	d, st
Eristalis tenax (L.), 1758	d, st
Eumerus funeralis Meigen, 1822	st
Eumerus ornatus Meigen, 1822	st
Eumerus sabulonum (Fallen), 1817	st
Eupeodes corollae (Fabricius), 1794	d, st
Eupeodes lapponicus (Zetterstedt), 1838	st
Ferdinandea aurea Rondani, 1844	c
Ferdinandea cuprea (Scopoli), 1763	st
Helophilus pendulus (L.), 1758	st
Heringia latitarsis (Egger), 1865	d, st
Heringia pubescens (Delucchi & Pschorn-Walcher), 1955	d
Mallota cimbiciformis (Fallen), 1817	sa
Melanostoma mellinum (L.), 1758	st
Meliscaeva auricollis (Meigen), 1822	st
Merodon avidus (Rossi), 1790	d, st
Merodon elegans Hurkmans, 1993	st
Merodon geniculatus Strobl, 1909	st
Milesia crabroniformis (Fabricius), 1775	st
Milesia semiluctifera (Villers), 1798	st
Myathropa florea (L.), 1758	st
Myolepta dubia (Fabricius), 1803	sa, st
Myolepta vara (Panzer), 1798	c, st
Paragus majoranae Rondani, 1857	d, st
Parasyrphus lineolus (Zetterstedt), 1843	d
Parasyrphus macularis (Zetterstedt), 1843	d
Parasyrphus malinellus (Collin), 1952	d
Parasyrphus punctulatus (Verrall), 1873	d
Platycheirus albimanus (Fabricius), 1781	st
Platycheirus scutatus (Meigen), 1822	st
Psilota anthracina Meigen, 1822	st
Riponnensia splendens (Meigen), 1822	st
Scaeva pyrastri (L.), 1758	st
Sphaerophoria scripta (L.), 1758	st
Sphegina clunipes (Fallen), 1816	sa, st
Sphegina elegans Schummel, 1843	st
Sphegina limbipennis Strobl, 1909	st
Sphiximorpha subsessilis (Illiger in Rossi), 1807	sa
Spilomyia manicata (Rondani), 1865	st
Spilomyia saltuum (Fabricius), 1794	st
Syritta pipiens (L.), 1758	d, st
Syrphus ribesii (L.), 1758	st
Syrphus vitripennis Meigen, 1822	d, st
Temnostoma vespiforme (L.), 1758	st
Volucella bombylans (L.), 1758	st
Volucella inanis (L.), 1758	st
Volucella inflata (Fabricius), 1794	st
Volucella pellucens (L.), 1758	st
Volucella zonaria (Poda), 1761	st
Xanthogramma pedisequum (Harris), 1776	st
Xylota segnis (L.), 1758	st
Xylota sylvarum (L.), 1758	st

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